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ABSTRACT

This paper describes the development of an instrument to assess the kinds of information literacy learning that take place in online courses. It includes the following sections: (1) Overview; (2) Variables; (3) Blueprint; (4) Validity; (5) Reliability; (6) Interpretations; (7) Bibliography; and (8) See the Instrument. The author hopes that developing the assessment tool and evaluating the results of validity and reliability tests will be helpful in designing specific course content which will help students to build their information literacy skills for use in all kinds of learning. The assessment might also be helpful in teacher training as teachers become interested in using computer technologies in their classes, both on campus and online. Also, development of appropriate assessment tools will help make educators and the public aware of a special value of online education: to develop necessary information-handling skills that students will need for future employment and academic work. The paper gives a brief overview of the instrument development project, discusses the variables used in assessing growth in information literacy, provides a blueprint for the information literacy achievement continuum, details the results of the validity and reliability tests, interprets the factors which influenced the results of the pilot study, and provides recommendations for modifications to the information literacy instrument. (CB)

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ED 470 643

Measuring Information Literacy: The "Tool Literacy" Variable

Cathleen Kennedy
December 1998

[NOTE: The purpose of this project was to develop an assessment instrument and then test it for validity and reliability in a small pilot study. The findings of this report focus on shortcomings of the instrument and recommendations for modifications for the future. The updated instrument is being tested in a larger study of over 200 on campus and online students in Spring 1999.]

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1. Overview
2. Variables
3. Blueprint
4. Validity
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6. Interpretations
7. Bibliography
8. See the Instrument

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Overview

Problem Definition: **Find a way to measure student improvement in using online tools for information literacy.**

Although there is ample evidence showing that college students do as well in technology-mediated instruction as they do with traditional instruction, there is a dearth of empirical evidence exploring the unique kinds of learning that take place in online courses. When we do see studies of student outcomes, they usually demonstrate that online and on-campus students perform equally well on traditional course final examinations (Berge and Collins, 1995; Deslisle, 1998; Deuchastel, 1997; Goldberg, 1996, 1997; Hiltz, 1995).

Many would agree that students learn more than the specified course content when taking a class. For example, in some courses students also learn communication and research skills, while in other courses, students do not. I am exploring a hypothesis that this extra learning is related to student engagement in the course and teaching pedagogy. Although it's problematic separating what is impacted by pedagogy from what is not, because pedagogy so profoundly affects motivation and student engagement, we can at least differentiate **how much** of this extra material individual students learn, and **what comprises** the extra material that all students are exposed to.

Teachers who use in-class group work, for example, add communication skills to the list of things students learn in class. When students are truly engaged in that process, they may learn more about communication than others do. Another example is teachers who assign research projects. Students will invariably learn something about research methods and techniques, but students who are more deeply interested in the subject matter may be more stimulated than others to learn how to conduct more complex research activities.

I am interested in discovering what kinds of information literacy learning takes place in online courses. To do this, I plan to use pre/post assessment of information literacy knowledge for students in online courses. I also hope to determine whether there is any predictive correlation between information literacy ability and performance in online courses. Ultimately, a correlation of information literacy ability and performance in any course format would be informative.

It is hoped that developing this assessment tool and evaluating the results will be helpful for designing specific course content to help students build these skills for use in all kinds of learning. This assessment might also be helpful for teacher training as teachers become interested in using computer technologies in their classes, both on campus and online.

Finally, development of appropriate assessment tools and writing about the findings will help make educators and the public aware of a special value of online education: to develop necessary information-handling skills that students will need for future employment and academic work.

Variables

There are several variables that could be used to assess learning growth in information literacy knowledge. I have borrowed the concept of information literacy from Shapiro and Hughes (1996) who developed seven dimensions of information literacy. My variables combine some of their dimensions, and simplify their theoretical meanings. In addition, I have drawn on suggestions made in a position paper produced by the American Association of School Librarians (1993) and Eisenberg and Johnson's work in defining "computer literacy" (1996).

The five variables I ultimately plan to assess are: tool literacy, resource/social-structural literacy, research literacy, publishing literacy, and emerging technology literacy. For this one-semester project, I focus on the Tool Literacy variable. To put it in context, the following five tables give brief descriptions of all the variables and suggest general indicators of achievement for each (see Tables 1-5).

Tool Literacy	**Definition:** Students can use individual tools such as email, browsers, CD-ROMs, and search engines as well as group-oriented tools such as listserv's, newsgroups, chatting, and conferencing to communicate with others and to find links to information. Students can use the appropriate information technology tool for specific purposes. They understand the strengths and weaknesses of each tool: email, conferencing, web pages, word-processing, chatting, listservers, etc. In addition, they can evaluate whether their final product meets the original project or task goals.
4	Students can plan a strategy for problem solving with online tools, and can determine whether they have met the task objectives.
3	Student can use all the tools, and can select best tool for specific tasks. Student can differentiate between different types of search engines and use the best one for a specific search. Student can use a variety of tools to access newsgroups, chat, join online conferences and can choose the best one for a specific group communication need.
2	Student can use all the individual tools correctly. Student can use a variety of search engines. Student is able to use at least one newsgroup reader, chat application or conference application.
1	Student can use some of the tools, such as a browser and email, correctly.
0	Student cannot use any internet tools correctly.

Table 1: Tool Literacy Variable

Resource/ Social-Structural Literacy	**Definition**: Students know where to find different kinds of information (literature, news, technical, peer-reviewed, etc.) and can use a variety of information formats such as print, web pages, charts, CD-ROM, databases, etc. to get that information. Students understand the social context of the information they find, particularly the source and purpose of publications and can differentiate between fact and opinion.
4	Student can summarize an article, web page, or chart and use it to defend a position. Student can integrate information found in various formats into a common summary. Student can explain the difference between information found in a newspaper, technical journal or reviewed journal and can identify biases. Student can find listings of resources of various types online.
3	Student can summarize an article, web page, or chart. Student can describe common biases found in media. Student can find listings of resources of various types online.
2	Student can accurately summarize text-based information.
1	Student can find text-based online and CD-ROM information.
0	Student is unfamiliar with online resources.

Table 2: Resource/Social-Structural Literacy Variable

Research Literacy	**Definition**: Students can formulate an information need, consider possible sources and develop a search strategy. Students can use research methods for evaluating information, discovering the thesis, argument and counter-argument in articles and can use this in their own writing. They can analyze, extract and use relevant information.
3	Clearly defines the information need and evaluates relevant information sources. Follows a clear search strategy, adapting to missing, incomplete, or irrelevant search outcomes. Can identify thesis, argument and counter-argument in sources. Can find sources supporting and contradicting their own premise. Can report findings using established research formats.
2	Clearly defines the information need. Develops a search strategy to find relevant information. Can identify supporting and contradicting information Demonstrates ability to investigate in some depth. Can report findings clearly.
1	Defines the information need. Finds relevant information. Identifies supporting and contradicting information. Can report findings.
0	Has difficulty stating the information need. Search is not well-focused or may be too simple. Can report findings.

Table 3: Research Literacy Variable

Publishing Literacy	**Definition:** Students can format and publish their ideas electronically, using word processing and web presentations with embedded graphics, sound, and video. They can use spreadsheets and charts to present ideas. They can organize and classify information accurately. They can cite references properly.
3	Can prepare textual and multimedia presentations, using formats appropriate to information dissemination and clarity including charts and graphics. Format is chosen to enhance the objective of the material.
2	Can prepare presentations using a variety of text and multimedia formats. Presentation design is used effectively. Can prepare charts accurately.
1	Can prepare simple word processed or html documents. Limited understanding of charting and graphic representation of data. Cites references properly.
0	Has difficulty defining information needs or cannot find relevant information.

Table 4: Publishing Literacy Variable

Emerging Technology Literacy	**Definition:** Students can learn to use new tools introduced in the course or through their research. They can determine efficacy of new methods over traditional methods and over other tools.
3	Can learn to use a new tool independently, using online references or documentation and can determine when this tools is better than another to perform a specific task. Can search for new tools that might enhance information research.
2	Can learn to use new tools independently. Knows how to find information about new tools.
1	Needs significant help to learn to use new tools. Limited ability to find information about using new tools.
0	Unfamiliar with finding new tools that can be used for information research.

Table 5: Emerging Technology Literacy Variable

In the next section I develop a blueprint for the *Tool Literacy* variable. This variable was chosen because it is the

easiest to assess without greatly modifying existing online course content—so, it can be completed this semester. It is, however, a variable that is rarely measured, even though the outcome of such an assessment could provide critical information to teachers and students. Teachers can gain insights into possible erroneous assumptions about student fluency with online tools and how that knowledge is acquired (since it isn't usually "taught"). Students may be impressed to find that they have greatly expanded their repertoire of tools for communication and research, or may be surprised to discover that there is even more to learn.

Blueprint for the *Tool Literacy* Achievement Continuum

1. **Define and delimit the area of learning *Tool Literacy* covers.**

   We want to assess what students know about using commonly available online communication and information-access tools. What knowledge do students bring with them and what do they learn while taking an online (for example) course?

   Students proficient in this area can use individual tools such as email and browsers, search engines, and group-oriented tools such as online conferences and listservers to communicate with others and to find links to information. Students can use the appropriate information technology tool for specific purposes. They understand the strengths and weaknesses of each tool and can evaluate whether their use of the tools meets the original project or task goals.

2. **Identify indicators of achievement (variable elements).**

   How do we know that a student has increased knowledge in tool literacy? There are several indicators, including:

   a. **Use of the tools (TU)**, e.g. can the student use email for basic and advanced tasks?
   b. **Ability to install and configure (IC)** some tools and **subscribe to** or **register for** others, e.g. can the student set up mail services in Netscape, can he subscribe to a specific listserver?
   c. **Knowing the strengths and purpose (SP)** of each tool, e.g what kind of information is usually found through listservers, conferences, and web pages?
   d. **Differentiating the usefulness (DF)** of similar tools for specific tasks, e.g. what tools can be used to gather data on regularly updated topics, and which tool would be best to find information about a

specific topic on an ad hoc basis?

e. **Developing a plan (PL)** for using the tools to solve unformatted (loosely constrained) information retrieval and dissemination problems, e.g. "Describe how you would research and report your findings about current use of ISDN in the home market?"

Why are these particular indicators important? The goal is to determine whether students become better investigators and analyzers when they have a rich collection of information-handling tools available, and whether they become more self-sufficient learners when they know how to use these tools effectively. Does the number of tools mastered have an impact on performance? Does mastery of certain tools automatically imply correct usage of others? Do students perceive value in having these tools available? Is student curiosity piqued when they have seemingly unlimited access to information? Ultimately, we want to find out whether using technology enhances a students' overall learning experience. Finding a way to empirically represent learning the tools of technology will be an important component of this work.

3. **Tasks that can be used to make observations about the achievement indicators.**

Research projects with clearly defined objectives and quantifiable outcomes will help determine knowledge levels and facility in using online tools for loosely structured research and communication tasks.

An online assessment instrument with several tasks to perform could be created to demonstrate the student's current facility in using prescribed tools in a more structured format. This type of task would be ideal for pre-test and post-test comparisons.

Sample **research project**:

> "Research (insert a current event related to the discipline being studied) and present a brief summary of what you learned. Use online tools and computer-based reference materials. When you have finished, join the online conference for this course and describe what you learned. Also describe which tools you used and why you chose them over other possible tools. If you can't get into the conference, send an email to the instructor."
>
> Highest level responses will include references to multiple search engines and possibly CD reference material. Students will search both news media and reference media. They will successfully post questions to conferences or existing listservers as appropriate to gather information and leads to new information. Students will be able to describe why they used the various search engines. Mid-level responses will include references to multiple search engines representing less diversity—either opinion only or "fact" only—than if both news media and reference media were used. They will successfully send a message to

the conference, but may overlook an appropriate pre-existing conference topic. Students should be able to describe why they used the search engines. Low level responses will use a CD reference only, or only one search engine. Students may not be able to post a message to the conference area, and don't have a good idea of why they used the tools because they are unfamiliar with the options available to them.

For **online assessment,** I designed a web page that includes a set of activities to be performed, including:

1. Accessing a web site and using a browser to submit a form.
2. Sending and receiving email. Forwarding email.
3. Participating in existing conference topics and creating new topics. Responding to a request that the student search the Internet for specific information on the topic.
4. Subscribing to listservers. Search for a listserver on a specified topic.

This kind of assessment instrument is especially helpful in evaluating tool usage because the tasks are very specific. The instrument can also function as a diagnostic tool to identify areas where students need improvement. Improvement over time is definitely anticipated, since these items are very skill-based and do not require a lot of analysis or judgment.

High level performers would be able to complete all the tasks, using appropriate tools for each task or subtask. They would also be able to explain why they chose to use specific tools. Mid-level performers would be able to complete some of the tasks. They may not be able to use advanced features of some of the tools, or perform non-trivial searches. They may not be able to differentiate between the uses of similar tools such as conferences and listservers. Low level performers might have difficulty finding the web page or sending email.

4. **Ways observations are recorded.**

***Design goals for the observations*:**

Curriculum relevance – We want to reflect a curriculum goal of deepening understanding of the use of technology tools for communication and investigation. To accomplish this, I ultimately intend to evaluate student performance on short performance tasks and on in-depth research projects. The pilot study will focus on performance tasks only.

Instructional utility – We want the assessment tools to provide helpful feedback to students about their learning and the importance of using technology tools appropriately. As students progress to higher levels of knowledge in each variable they demonstrate increased understanding of the

purposes of the tools they apply to solving problems, answering the question "Why do it that way?" This, in turn, helps students develop better plans of attack in investigating.

Established precision – In order to improve confidence in the findings it will be desirable to evaluate a variety of tasks, multiple observations of each type of task, and several observers or raters for each student. Due to time constraints this objective will not be met in the pilot study.

Verifiable consistency – To help ensure consistent rating of observations, a set of student work will be graded by several raters. Then, the raters will be shown how other raters rated the same student work. We will try to adjust for differences in ratings. Again, due to time constraints, this activity will not be included in the pilot study.

Some of the challenges in evaluating student research projects include creating context-appropriate projects, ensuring that research tasks assigned to students will be of similar complexity from one course to another, and finding agreement among the raters as to "best" approaches. In addition, fitting a research project into online courses that are already under way is problematic. For these reasons, I did not include research projects in this study.

Recording observations for the pilot study:

The *Online Tools Assessment Survey* (OATS) was the only instrument used in the pilot study (see Appendix A). Respondents interacted with a web-based form, completing a series of demographic questions and then performing tasks that require use of online tools. Student responses were collected in four ways:

1. Some forms were automatically submitted by email (in the first version of the form).
2. Later forms were collected in a text file located on a central web server through a Perl script that is activated when the student completes the online form.
3. Some responses to tasks were collected by email.
4. Other responses to tasks were observed directly by reviewing conference participation.

Challenges in gathering data for pilot study:

I began by working with one teacher who was teaching the same college course in a traditional on-campus format as well as an online format. He had about 15 students in both sections of the course. We decided completion of the survey would be an optional activity for the students, since it required a significant investment of time to complete (30 – 45 minutes over a two- or three-day period). To make the survey

both self-explanatory and optional for both groups, a letter was mailed to on-campus students and an email was sent to online students describing the survey and its purpose (see Appendix A). Both groups were given the web address to find the survey online. The survey had two parts, 1) a form to be filled out and submitted online, and 2) three tasks involving the use of online tools.

Of the 25 students contacted, six responded, and four of those students had difficulty submitting the form. I learned that some students' browsers were not automatically submitting the forms with the HTML "mailto:" command. This necessitated rewriting the survey with a CGI (Common Gateway Interface) Perl program to gather the data directly without relying on the user's browser setup. Students who had partially completed the survey were contacted and encouraged to try completing the form part of the survey again. Two students followed up, providing me with four completed surveys and two partially completed surveys (the form was not completed and some of the tasks were completed).

Although this small sample provided great feedback on the structure of the online instrument, it did not provide enough data to analyze the content of the survey. In addition, only one respondent was an online student, so I would not be able to do any comparative analysis between on-campus and online students. I then contacted about 40 former students that I keep in regular email contact with and asked them to try the survey. Most of these students work full time and some have not been students for quite awhile. 23 responded, which gave me enough cases to evaluate the instrument. Unfortunately, most of these respondents are experienced users of online tools, so I did not get a sample of diverse experience levels.

Some of these respondents also reported difficulties submitting the form, so some of the data gathered from this group is also incomplete. Several respondents only completed one item. I did a follow-up, email version of the form, which some completed and returned. At the time that I began analyzing the responses, there were 19 complete responses from 29 total respondents. Five responses had only one item answered. Fortunately, when I analyzed the cases, only one case had to be removed. This was an individual who only answered one item, but it was one of the most difficult items. The rest of the single-response cases answered easier items, allowing the estimate-based analysis to execute correctly.

5. How students' performance was calibrated.

I began by trying to calibrate performance on the four tasks (see #3 above) using the SOLO Taxonomy. Responses to each task were assigned a value ranging from 0, indicating non-responsive, to 3, indicating a high-level response (see discussion of Variables in the Overview Section). Several problems became apparent as I attempted this type of scoring. First, each task was comprised of several smaller, observable skills. Students earning scores of 1 or 2 earned them for different reasons. For the purpose of providing useful student diagnostics, it was desirable to have more detailed information to report back to students. Second, the sub-tasks

of the tasks were from different areas of tool use. For example, both task 3 and task 4 required use of search engines, but there was no specific "search engine" task, making it difficult to know from the scoring whether a student had used search engines successfully (since there were other reasons not to earn a 3 on a task).

The next phase in calibrating student scores involved breaking the tasks down into smaller items, or sub-tasks. This yielded a total of 11 items. I then tried to score each item using the same 0, 1, 2, 3 scoring guide. At this point, however, I found the tasks to be so simplified, that it was impossible to rate some tasks at the 2 or 3 level. I decided to use dichotomous scoring on the 11 items. The items, with their associated tasks and variable elements are shown in Table 6 below:

Item	Activity	Original Task	Variable Element
1.	Submit the survey.	1	TU
2.	Send an email to a specified address.	2	TU
3.	Read an email response, open an attachment, and forward the email to another specified address.	2	TU
4.	Participate in an existing online conference by posting a message to the pre-existing topic "Survey Task 2."	3	TU
5.	Participate in an online conference by creating a new topic area with a question.	3	IC
6.	Respond to postings in the new topic area by searching for information on a specified topic and describing your search.	3	SP, PL
7.	Differentiate between using email and using an online conference.	3	SP
8.	Subscribe to a listserver and describe how you subscribed to it.	4	IC, PL
9.	Find a listserver about a specified topic and describe how you found it.	4	SP, PL
10.	Differentiate between using a conference and a listserver.	4	DF
11.	Differentiate between using email and a listserver.	4	SP

Table 6: Items

I also developed a hypothesis regarding relative difficulty of the individual items. It was helpful to categorize items by specific online tools, since some tools are more difficult to use or less commonly known than others. Then, items would be placed on a continuum of relative difficulty for each tool. This generated both a Diagnostic Profile, useful for reporting back to students, and a hypothetical difficulty continuum for the items to be used in evaluating the instrument (see Table 7).

	Easy	Medium	Difficult
Browser	1		
Email	2 3		
Conference	4	7 5	
Search Engines			6 9
Listserver		11 8	10

Table 7: Diagnostic Profile

To validate the data, I ran Quest ITANAL on all the data, 29 cases with 11 items. This resulted in an initial internal consistency of 0.84. I then ran ESTIMATE on all the data. After performing a fit analysis, the system would not report any case estimate information, although item estimate information was reported and no items had an INFIT t factor outside the range –2 to +2. This lead me to suspect that some of the cases were extreme. I ran a case fit analysis and found that one case had an INFIT t value of 4.00. In examining the raw data for this case I found that this individual answered only one item, and it was one of the most difficult items. By removing this one extreme case, the rest of the data analysis proceeded smoothly. One item, item 5 ("start a new conference topic"), had an INFIT t of 1.6 indicating that it was more discriminating than we'd like. I left the item in, since it was within the reasonable range, but this quite likely affected the relative position of this item on the difficulty continuum. (As an experiment, I also ran ESTIMATE with item 5 removed. This produced a much worse overall item fit, with two other items having high INFIT t values.)

Results

Validity Results

Criterion Validity – *How does performance on the instrument compare with the criterion of success in a course?*

- The instrument is supposed to test "online tools ability" as a **predictor of success** in online courses. Unfortunately, the number of responses from students enrolled in the specified course was insufficient to perform this analysis.

- I also looked for correlations between "years of experience using email and browsers," "grade in most recent English course," and "units of college credit completed" with "online tools ability" (see Table 8).

[Table Omitted]

These correlations initially look interesting in that they are negative. This suggests that further analysis should be performed on the next study. Part of the reason for this could be that there was very little variation in the experience, grades, and units reported by the majority of respondents. Of those responding to these questions, most had more than two years of experience using online tools (81%), earned an A in their last English course (82%), and had completed 120 or more units of coursework (74%).

The instrument was designed to be used as diagnostic tool early in the course. Performance on the instrument did support my hypothesis about difficulty (see "Content Validity" below), and the item breakdown was sufficient to identify specific areas where students could improve, so it looks like a good diagnostic tool.

Content Validity – *Does the instrument cover content instructors and other experts deem relevant to success in online courses?*

- Content was derived from discussions with faculty and review of proposed standards for information literacy.

- Items cover basic and advanced use of commonly used online tools: browsers, email, conferences, listservers, and search engines. The Item Fit analysis demonstrates that the items fit the model of assessing the ability to use online tools effectively. The few outlying items are still within the acceptable range (see Table 9). In a later section I discuss what happened when item 5 was removed.

[Table Omitted]

Construct Validity – *What accounts for high scores on the instrument?*

- Analysis of the mapping of cases to items largely supported my hypothetical ranking of items from easy to difficult. My hypothetical ranking of items, from easy to difficult was:

2 1 3 4 7 11 5 8 6 9 10

Quest's ranking of items, was:

2 4 1 5 [3 7 11] 8 6 9 10

Although Quest ranked item 5 (add a new topic to a conference) easier than item 7 (differentiate between using email and a conference), item 7 had some false-negatives because it is a question related to the form-submission problem. If all respondents had submitted the form, this result might have been different.

Quest's ranking of items, using only complete responses, was:

2 4 [5 7 11] 3 8 6 [9 10]

This at least places items 5 and 7 at an equivalent level of difficulty. It moves item 3 (forwarding email), however, to a much higher ranking than expected. Ultimately, these results are suspect because of the skewing toward high-performing respondents, problems encountered submitting the forms, and the voluntary nature of responding (see Table 10).

- Explore reasons other than "respondent knows how to use online tools well" for good performance:

Participants may perform well because the tasks "give away" some of the answers. In addition, these participants were highly motivated to demonstrate how capable they are, since they are my former students and are also interested in my referrals for jobs.

[Table Omitted]

Reliability Results

To evaluate whether the instrument measures performance consistently, I examined Cronbach's alpha, which was 0.83 and the separation reliability factor, which was 0.70, using the 28 good cases. When I evaluated these factors for the complete cases, I found a Cronbach's alpha of 0.73 and separation reliability of 0.69. These are much more consistent, and probably a better indicator of the true internal consistency of the instrument. These values are sufficiently high for an instrument with only 11 items (see Tables 11-12).

[Tables Omitted]

Interpretation of Pilot Results

A number of interesting factors influenced the findings of this pilot study. First, significant problems were encountered in collecting the data, resulting in data that was heavily skewed with responses from individuals who have extensive experience using online tools, and a high proportion of incomplete responses (34%). In addition, most of the respondents were not current students and really had no compelling reason to persevere and complete the instrument. Several reported that they "ran out of time" working through the tasks, so those responses are not reflective of true ability levels.

I also had very disappointing response from the actual target audience of current students, despite two follow-up contacts. In the case of on-campus students, this may be explained by the fact that many have no experience using any web tools at all. Unfortunately, this version of the instrument had no way to gather that information. Online students may have tried to use the first version of the instrument, found it difficult to use, and then given up. These online students may also be novice Internet users, and more easily discouraged than the group of former students I contacted later.

A final problem was the instrument itself, in that it did not cover advanced aspects of using online tools. This was highlighted as a deficiency with this particular sample because so many respondents were experienced users. In a "normal" group of students, I may have found the items appropriate.

These problems will be resolved by using the instrument as a required pre-test instrument and redesign of the instrument format. Using the instrument as a pre-test will also allow me to correlate initial ability with student outcomes in courses. If the instrument is also used as a post-test, I can compare results to determine change.

Using the instrument for pre/post testing also would allow me to experiment with two test groups, one in a class where the instructor is informed of the "deficiencies" and encouraged to provide links to web resources that teach the use of online tools. The instructor of the other class would not be given a report of deficiencies and not encouraged to provide the links. Teachers would not be informed of this aspect of the experiment in advance.

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